Armstrong Research Flight Center Flight Mechanics Capabilities

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Outline

- **Trajectory Design and Analysis**
- **Flight Performance and Analysis**
- **Flight Mechanics Testing and Flight Operations**
- **Meteorology**
- **Modeling and Simulation for Flight**
- **Facilities**

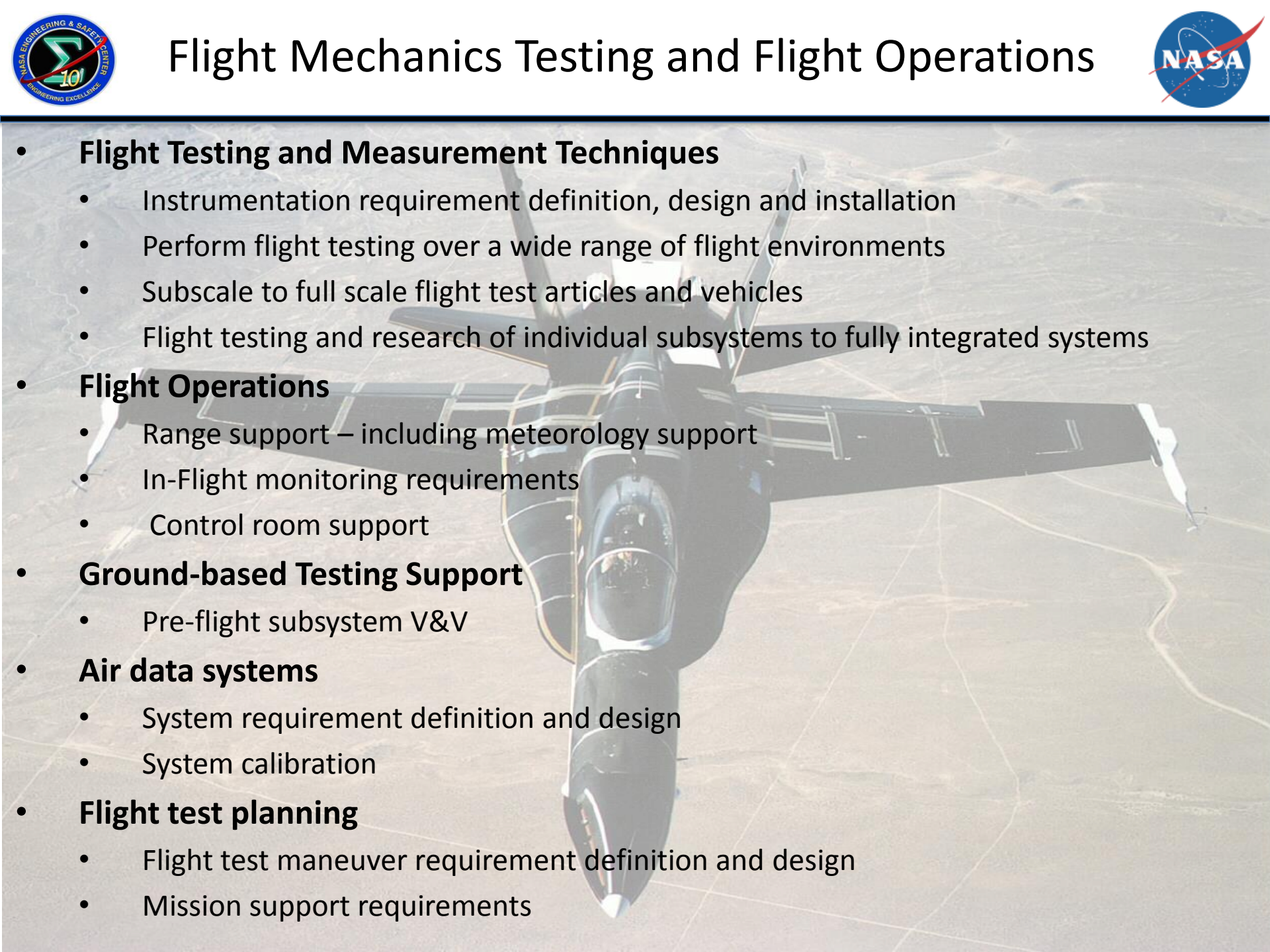
Trajectory Design and Analysis

- **Trajectory Design and Optimization**
  - Optimized vehicle trajectories
  - Using simulations to design trajectories
- **Trajectory Reconstruction**
  - Reconstructed Best-Estimated Vehicle Trajectory (BET)
  - Reconstructed Best-Estimated Atmosphere (BEA)
- **Supporting Air Traffic Management**
  - Using autonomous aircraft research with trajectory research

Flight Performance and Analysis

- Vehicle Performance
- Vehicle Dynamics
- Flying Handling Qualities
- System Identification
- Flight Performance
- Requirements, Certification and Model Validation

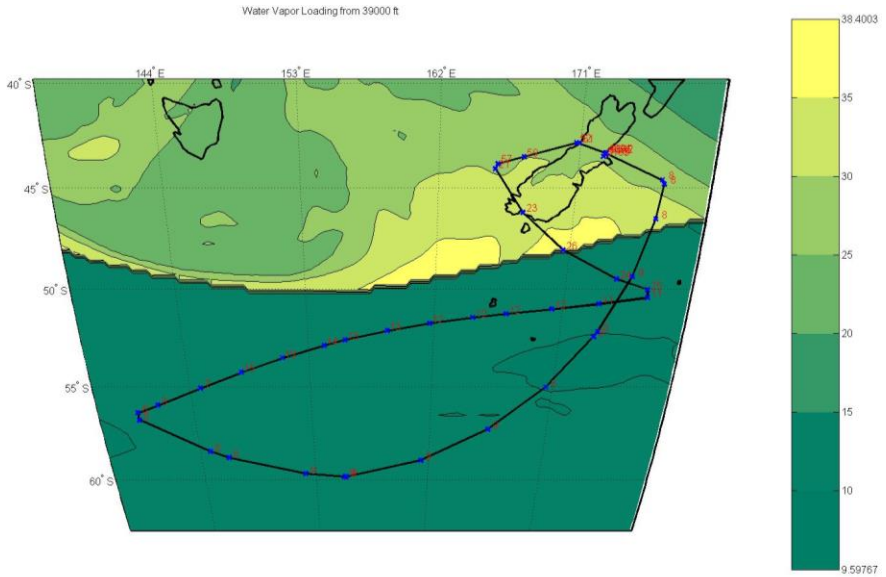
Flight Mechanics Testing and Flight Operations

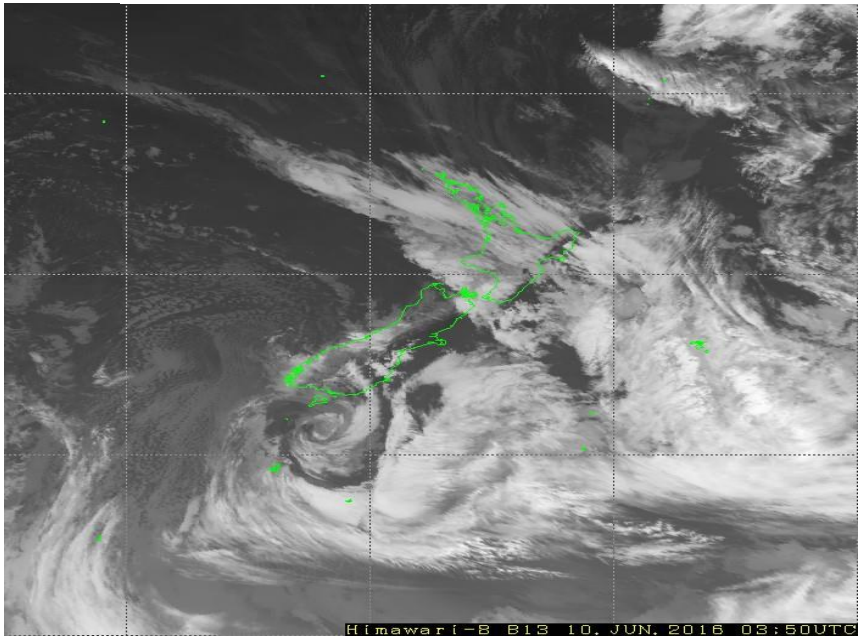


- **Flight Testing and Measurement Techniques**
  - Instrumentation requirement definition, design and installation
  - Perform flight testing over a wide range of flight environments
  - Subscale to full scale flight test articles and vehicles
  - Flight testing and research of individual subsystems to fully integrated systems
- **Flight Operations**
  - Range support – including meteorology support
  - In-Flight monitoring requirements
  - Control room support
- **Ground-based Testing Support**
  - Pre-flight subsystem V&V
- **Air data systems**
  - System requirement definition and design
  - System calibration
- **Flight test planning**
  - Flight test maneuver requirement definition and design
  - Mission support requirements

Meteorology

- **Forecasts and courtesy briefings**
  - Winds, gusts, visibility, clouds, particulates, water vapor loading
- **Hazards**
  - Turbulence, icing, wind shear, T-storms, IFR conditions, mountain wave, lightning
- **Flight/project support**
  - Crew briefs, T-x briefings
  - Full-time in-flight weather monitoring
- **Best-Estimate-Atmosphere**
  - Trajectory analysis for atmospheric parameters
  - Airdata calibration
  - RVSM
- **Climatology**
  - Project planning studies
- **Real-time ground measurements**
  - Extensive weather station network
- **Mobile balloon launches**
  - Portable for project specific applications





Modeling and Simulation for Flight

- **Flight Simulation Development**
  - Simulation architecture definition, design, and implementation
  - Pilot-in-the-loop simulations
  - Hardware-in-the-loop simulations
  - Model validation using flight test data

- **Subsystem Modeling**
  - Aerodynamic models
  - Control models
  - Structural models
  - Mass property models
  - Aero-servo-elastic models
  - Propulsion models
  - Atmospheric models
  - Uncertainty models
  - Tow line dynamic models

Facilities (Modeling and Simulation for Flight)

- **Simulation Systems Development Lab**
  - A small facility for maturing and testing simulation technology
- **Currently have simulations for all major projects**
- **Each simulation occupies their own room**
  - In general each can have full to partial cockpit
  - Can be run with all software or with hardware in the loop

- **Major Assets for Modeling and Simulation for Flight**
  - F-18 Simulation
  - F-15 Simulation
  - GIII Simulation
  - X-56 Simulation
  - Dreamchaser/HL-20/TGALS Simulation
  - Hybrid Wing Body Simulation
  - HEIST Simulation

Facilities (Current Research Aircraft)

F-15B 836

- A substantially instrumented research F-15B airplane with the capability to carry research on the centerline store.

GIII 804

- A substantially instrumented GIII airplane modified to support aerodynamic research.

X-56

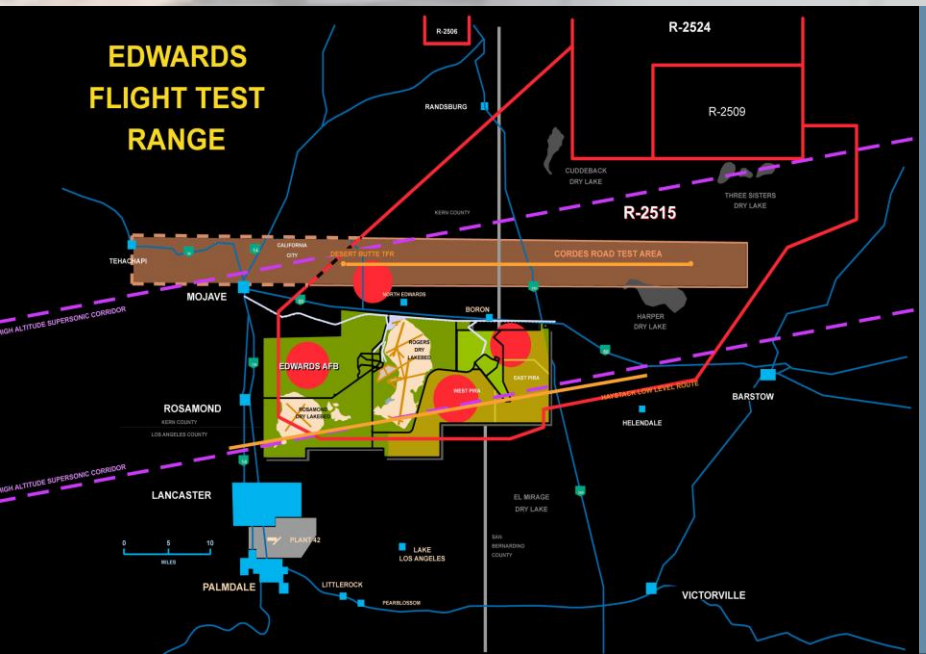
- An instrumented experimental unmanned airplane with replaceable wings.

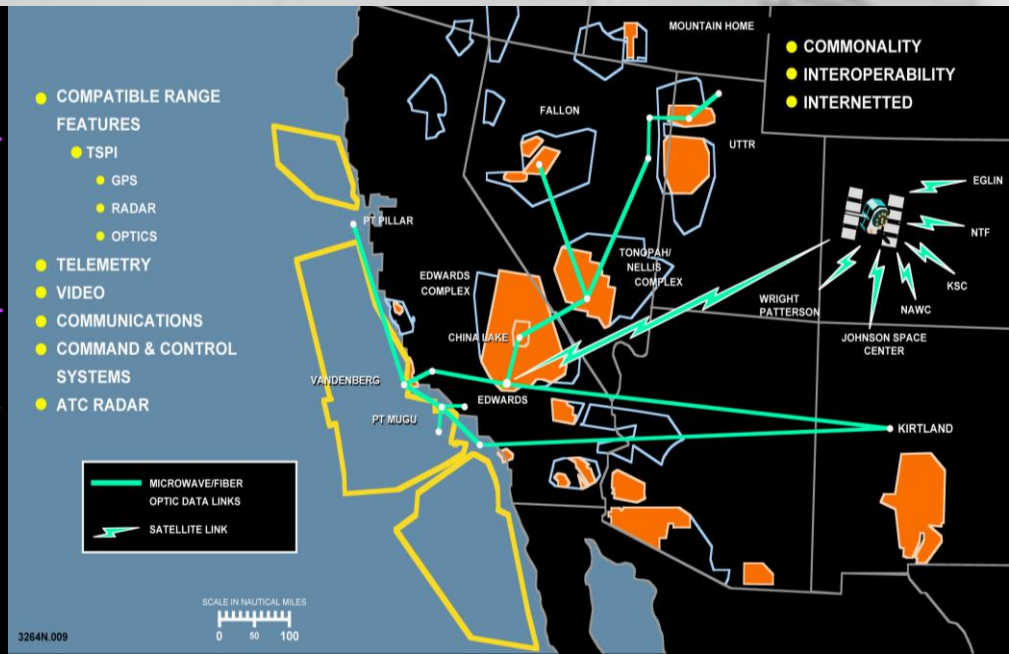
Facilities (Facility Support)

- **Consolidated Information Technology Center (CITC)**
  - A facility dedicated to processing, storage, and access of flight and ground test data.
- **Dale Reed UAS Model Shop**
  - A facility for fabrication and model build-up of vehicles and small parts used for subscale flight research.

Facilities (Test Ranges)

- **Dryden Aeronautical Test Range (DATR)**
  - Infrastructure for conducting flight tests including a tracking radar, data processing systems, and control rooms.
- **R2508 Restricted Airspace**
  - Restricted and controlled airspace available for flight test and flight research.
- **High-Altitude Supersonic Corridor**
  - High altitude restricted airspace corridor for conducting supersonic flights over land.
- **Black Mountain Supersonic Corridor**
  - Low altitude restricted airspace corridor for conducting supersonic flights over land.





Software Tools

- **Flight Performance and Analysis**
  - pEst
  - SIDPAC
  - Athena Vortex Lattice (AVL)
  - Digital datcom
  - MATLAB/SIMULINK
  - ODE (Omega Data Environment)

- **Trajectory Design and Analysis**
  - POST (Program to Optimize Simulated Trajectories)

- **Flight Mechanics Testing and Flight Operations**
  - IADS
  - FDAS (Flight Data Access System)

Summary

- Armstrong focus is on flight testing and flight research
- Do have ability to conduct trajectory design and analysis
- Capabilities in model development and implementing simulations
- Capabilities in Flight prediction and analysis